

The Role of NAIC in Responding to Climate Change

Testimony to the National Association of Insurance Commissioners
Climate Change & Global Warming Executive Task Force
NAIC Winter Meeting, San Antonio, TX
December 8, 2006
(Final Print Version: December 31, 2006)

Evan Mills, Ph.D.¹
Staff Scientist
Lawrence Berkeley National Laboratory
University of California
Berkeley, CA 94720 USA
<http://eetd.lbl.gov/insurance>

I would like to begin by thanking Director Wagner (NE) and Commissioner Kreidler (WA) for their vision in taking up this important topic, and the entire NAIC Climate Change & Global Warming Task Force for providing this forum to myself and today's other speakers.

I have worked in the energy and environment field for over twenty years, primarily at the U.S. Department of Energy's Lawrence Berkeley National Laboratory, which is managed for DOE by the University of California. For the past decade I have studied in depth the question of the impacts of climate change on the insurance industry, both in the U.S. and abroad, publishing over 50 reports and articles on the topic, including a recent synthesis in the journal *Science*.²

My testimony today is structured to address the three questions set forth in your Task Force's charter.

- 1. Implications of climate change on the insurance sector**
- 2. Insurers' knowledge of potential climate change impacts**
- 3. Recommendations on steps that regulators could take to assure that they are adequately monitoring insurers' activities with regard to managing the financial condition and performance of insurance markets**

The first of these is dealt with in depth in a report entitled "The Availability and Affordability of Insurance Under Climate Change,"³ which I wish to submit to the record of this session. This was co-authored by myself, Eugene Lecomte, President Emeritus of

¹ These remarks and the background materials submitted for the record have benefited from discussions with Gene Lecomte (President Emeritus, Institute for Business and Home Safety), Richard Roth, Jr. (Bickerstaff, Whatley, Ryan & Burkhalter Consulting Actuaries), and Paul Epstein (Harvard Medical School). The opinions expressed in this report are those of the author and do not represent the views of the U.S. Department of Energy, Lawrence Berkeley National Laboratory, or the University of California.

² Mills, E. 2005. "Insurance in a Climate of Change," *Science* Vol. 308:1040-1044. 12 August.

³ Mills, E., R.J. Roth, E. Lecomte. 2005. "Availability and Affordability of Insurance Under Climate Change: A Growing Challenge for the U.S." Prepared for The National Association of Insurance Commissioners.

the Institute for Business and Home Safety, and Richard Roth Jr., former Chief Property and Casualty Actuary for the Department of Insurance, State of California. Richard also served as Chairman of the Casualty Actuarial (Technical) Task Force at the NAIC, and was active on two catastrophe insurance committees.

I will spend the balance of my time offering 12 specific recommendations for activities in which I think NAIC can play a leadership role. You will find considerably more detail in my written remarks, as well as extensive bibliographic references that may prove useful.

1. Implications of climate change on the insurance sector

Let us begin with the implications of climate change on the insurance sector, which serves as a national—and increasingly global—integrator of catastrophe costs across all sectors of the economy, and messenger of these impacts through the terms and price signals it projects to its customers. It provides a critical function within the global economy by helping create the certainty that businesses need in order to invest and grow.

At various points in history—the Great Dust Bowl of the 1930s, urban riots of the 1960s, and terrorism today—watershed events or trends ushered in structural changes within the insurance industry. While entirely different in their specifics, each of these watersheds had in common an element of acute surprise *followed by* the subsequent realization that the future would not be like the past. Global warming is the next watershed of this type. The growing incidence of extreme weather events poses an enormous challenge to the insurance industry, and I believe that the industry is up to it – especially if assisted by its regulators. I would only add that while the challenges have been growing, insurance itself has been taking on a broader swath of risks as its appetite has broadened from a “fire-only” industry toward an all-perils one. So, there are two moving targets here.

Rising weather-related losses are expected (Exhibit 1), which will have adverse impacts on insurance affordability and availability. In Florida and Louisiana alone, more than 600,000 homeowners' property policies have been cancelled or not renewed in the past year. The residual markets contain about 3 million customers today, and rising. Left unchecked even more of the burden will shift to consumers and governments and growth of the industry itself could be slowed.

It is sobering to note that the average annual insured losses from weather-related catastrophes exceed that of the September 11th attacks, and yet they receive only a fraction of the attention. I'm told by Director Wagner that loss-ratios are higher Nebraska due to hailstorms than those in New York following 9/11.

If we are concerned about terrorism, shouldn't we be equally concerned about global warming and climate change? The U.S. Department of Homeland Security views the risks of hurricanes and terrorism as similar.⁴

⁴ Sclafane, S. 2006. “Allstate Prez Pleads for United Cat Front,” *National Underwriter*, Nov. 27, p. 8.

An international consortium of insurers released a new study last month in Nairobi stating that the global economic costs of extreme weather events are doubling every twelve years, and that a probable maximum loss (PML) of \$1 trillion can now be anticipated. This PML is up a remarkable six-fold from that issued by the same group just four years ago.⁵

This is seen as the combined effect of increasing vulnerability of human infrastructure (the dominant factor) and climate change. What is particularly worrisome is that the trends in human activity and our changing climate are only serving to compound one another. One of the US insurance industry's leading catastrophe modelers, Robert Muir-Wood is currently helping to unravel this attribution puzzle.⁶

At the most conceptual level, I have seven broad concerns about the implications of climate change for insurers and their customers. They are:

1. The rising level and declining predictability of extreme weather events coupled with rising incidence of linked losses previously believed to be uncorrelated, and the obvious conundrum that presents for actuaries;
2. While many who are sanguine about insurers' ability to adapt to climate change predicate their views on the assumption of gradual change, the reality is that abrupt climate change is a serious possibility and can lead to much more traumatic outcomes, as illustrated by the Great European Heat wave of 2003 which resulted in temperatures nearly *six standard deviations* from the long-term norm (Exhibit 2)⁷;
3. The sometimes astounding lack of fundamental data on insured losses and exposures, and the weaknesses within existing catastrophe models and the often insufficient ability of insurers and others to apply those models properly;
4. The largely unanticipated correlation between insurers' core business and their investments, and the potential "perfect storm" of demands for payouts and loss of consumer surplus through the impact of mega-catastrophes on financial markets;
5. The current tendency for *non*-US insurers to be more advanced in their analysis of and responses to climate change, and the adverse implications this may eventually have for the global market share enjoyed by U.S. companies. Allstate has stated that they are "getting smaller everywhere around the country" in response to rising natural disasters;⁸
6. The particularly difficult business environment that will appear in the emerging markets of Asia, Africa, and Latin America where US-domiciled insurers are already expanding aggressively; and

⁵ Dlugolecki, A. 2006. "Adaptation and Vulnerability to Climate Change: The Role of the Finance Sector." United Nations Environment Programme. <http://www.unepfi.org>

⁶ Wood, R-M., S. Miller, A. Boissonade. 2006. "The Search for Trends in a Global Catalogue of Normalized Weather-Related Catastrophe Losses," in "Climate Change and Disaster Losses Workshop: Understanding and Attributing Trends and Projections," 25-26 May 2006, Hohenkammer Germany.

⁷ Schar, C., P.L. Vidale, D. Luthi, C. Frei, C. Haberli, M.A. Liniger, and C. Appenzeller. 2004. "The Role of Increasing Temperature Variability in European Summer Heatwaves," *Nature* 427:332-335.

⁸ sclafane, S. 2006. (op cit.)

7. The threat to insurability itself, as manifested by the already apparent crisis in availability and affordability today in the U.S. A shift to publicly funded insurers of last resort will be appropriate in some cases, but should indeed be a measure of *very* last resort. It is highly preferable to find market-based solutions rather than allowing markets to fail and plugging the proverbial dike with inferior government solutions.

I would like to continue with a few remarks about the implications for property and casualty (P&C) and life and health (L&H) lines.

Property and Business Interruption

Climate change has the potential to affect virtually all segments of the P&C business—including those covering damages to property, crops, and livestock; business interruptions, supply-chain disruptions, or loss of utility service; equipment breakdown arising from extreme temperature events; and data loss from power surges or outages. With one important exception, these have been discussed at length in the document just submitted to the record. That exception is the rising specter of climate-change-related liability.

Liability Risks

While the most widely discussed insurance-related consequences of climate change concern property damages from extreme weather events, there is increasing awareness of the more-subtle but equally material dimension of liability. Even for those who believe that the *physical* impacts of climate change may not cause observable insurance losses for some time, it is clear that liability-related claims *are* already being made. Legal triggers include nuisance, negligence, breach of statutory duty, and breach of human rights. We discuss this issue in depth in an article currently under review for a joint publication of the *Stanford Environmental Law Journal* and *Stanford Journal of International Law*.⁹

The relevant categories of insured liability include:

- Environmental liability for emitters of greenhouse-gases
- Environmental liability associated with toxic releases, mold, and other consequences of the physical impacts of climate change (e.g. releases following hurricanes)
- Public nuisance claims resulting from air pollution – liability for an unreasonable injury to a right common to the general public that causes harm to life, health or property¹⁰
- Product liability associated with materials or products that contribute to the greenhouse effect

⁹ Ross, C. and E. Mills. 2006. "A Review of Insurance Liability Considerations in the Context of Global Climate Change, submitted to the *Stanford Environmental Law Journal* and *Stanford Journal of International Law*.

¹⁰ Monk, B. 2006 (forthcoming, American Bar Association). Excerpt from "Global Climate Change and U.S. Law." Editor Gerrard, M.

- Sarbanes-Oxley related liabilities for corporate officers (including insurers) involved as emitters or arising from obligations to safeguard shareholder value from the consequences of climate change
- Business interruptions as triggers of liability claims against providers of utility services
- Fraud-related claims triggered by sources of misinformation on climate change¹¹
- Political risk claims triggered by new government policies and the like

Addressing climate change with litigation is both inefficient as well as expensive. In light of various federal district court decisions where the common law nuisance theory has been rejected as a basis for litigating corporations that emit GHGs, litigation is may not be an effective avenue to controlling U.S. GHG emissions.¹² Whether climate change lawsuits are successful and GHG emitting companies are held liable for their emissions, significant litigation costs will be incurred by defendants.¹³ Controlling litigation costs is of paramount importance to NAIC.

Responses to climate change, whether they are in the realm of adaptation or mitigation, will also entail liabilities for insurers and their customers. These include considerations for existing and new energy technologies, both on the supply- and demand-side of the equation, as well as liabilities associated with market-based carbon-reduction strategies such as trading or offset schemes.

I believe that the insurance industry faces material liability exposures to both the causes and consequences of climate change, many of which have already begun to materialize. Responses to climate change, particularly in the energy sector, can be distinguished by their potential for enhancing or reducing liability. Some responses, e.g. a resurgence of nuclear power, appear not to be commercially insurable given persistent uncertainties about their risk characteristics and the refusal of the commercial insurers to assume this risk up until now.

Health and Healthcare Infrastructure

I will shift now to the implications for health and healthcare, as that area has received less attention from the insurance industry.

The life/health segment represents well over half of U.S. insurance premium volumes. Climate influences many of the most important diseases. Climate *change* is expected to adversely impact the prevalence of vector-borne diseases, heat stress, water quality, asthma associated with increased aeroallergens (such as pollens¹⁴ and mold), and the health of non-human systems, which, if compromised, can cause economic and insured

¹¹ Marshall, E. 2006. "Royal Society Takes a Shot at ExxonMobil." *Science*, 313:1870, 29 September.

¹² Rohleder, J. and J. Button. 2006. "The Legal Dimensions of Climate Change: Conference Report." Sustainable Development Law & Policy: Climate Change Law Special Edition.

¹³ Arras, B.L. 2006. "Toxic Torts and Environmental Law, Global Warming Legislation: Cooling down or Heating up in the Private Sector?." DRI, Winter 2006: 4-8

¹⁴ Pollen has been observed to increase by 60% with a doubling of pre-industrial atmospheric carbon-dioxide concentrations (see Epstein and Mills, 2006).

losses for humans (e.g. forest beetle infestations leading to timber loss and wildfire). It is the last item – the health of forests, crop systems, wildlife, livestock and marine life (e.g. coral reefs) – that links directly to industries and the “health of their assets” (timber, agriculture, poultry, and fisheries; to investors and insurers), as well as to public health via deterioration of life support systems.

An in-depth treatment of health issues is provided in the study entitled “Climate Change Futures: Health, Ecological, and Economic Dimensions,”¹⁵ conducted by the Harvard Medical School’s Center for Health and the Global Environment and sponsored by Swiss Re and the UN Development Programme.¹⁶ I served as co-editor and am submitting a copy of that study to today’s record. The project included intensive corporate stakeholder involvement over a multi-year period and tapped 27 core authors and 24 reviewers from the fields of insurance, epidemiology, public health, veterinary medicine, agriculture, marine biology, forestry, ecology, energy systems, economics, climatology, and conservation biology. I want to say that it was truly impressive how many people participated in the project from within Swiss Re, ranging from public affairs, to research, to underwriting, to asset management.

There are at least nine major categories of anticipated health impacts with implications for insurance, some of which are elaborated in the CCF study (coupled with recommendations for loss minimization). These include:

1. Infectious diseases (such as vectors ranging from mosquitoes carrying Malaria or West Nile Virus, to ticks carrying Lyme Disease,¹⁷ to rodents carrying Hantavirus)
2. Heat stress (few in the U.S. are aware that upwards of 35,000 people died in excess of the norm due to the European Heat Wave of 2003) (Exhibit 2);
3. Respiratory and coronary disease
4. Waterborne diseases exacerbated by temperature and water quality, or overwhelmed water treatment infrastructure after floods
5. Physical injury from extreme events and natural disasters, e.g. flooding, as well as the tendency for disease outbreaks to cluster around extreme weather events,¹⁸ “Katrina Cough”, etc.
6. Effects of toxic materials released and distributed by extreme weather events
7. Food poisoning (e.g. there is a strong correlation between Salmonella outbreaks and

¹⁵ Epstein, P. and E. Mills (eds.). 2005. “Climate Change Futures: Health, Ecological and Economic Dimensions.” Published by Harvard Medical School, sponsored by Swiss Re and the U.N. Development Programme. Contributing Authors: P. Anderson, J. Brownstein, U. Confalonieri, D. Causey, N. Chan, K. L. Ebi, J. H. Epstein, J. S. Greene, R. Hayes, E. Hofmann, L. S. Kalkstein, T. Kjellstrom, R. Lincoln, A. J. McMichael, C. McNeill, D. Mills, A. Milne, A. D. Perrin, G. Ranmuthugala, C. Rogers, C. Rosenzweig, Colin L. Socolne, G. Tabor, M. Vicarelli, X.B. Yang.

¹⁶ Epstein, P. and E. Mills (eds.). 2005. “Climate Change Futures: Health, Ecological and Economic Dimensions.” Harvard Medical School. UN Development Programme, and Swiss Re.

¹⁷ Case study in the CCF study (Epstein and Mills (eds), 2006) projects a four-fold increase in the suitable range for Lyme disease in North America by the year 2080, based on Brownstein, J. S., Holford, T. R. & Fish, D. Effect of climate change on Lyme disease risk in North America. *EcoHealth* 2, 38-46 (2005).

¹⁸ Epstein, P. R. Climate and health. *Science* 285, 347-348 (1999).

- temperature)
8. Post-event mental health problems
 9. Health consequences of malnutrition and water shortages in developing countries

More detail on these is provided in Exhibit 3.

One of the strengths of the Harvard study is that it looks at the multifaceted (i.e. real-world) patterns of impacts. For example, extreme heat catastrophes can trigger health problems and loss of life; but also cause acute crop damages; shutdowns of electric power plants; wildland fires; flooding and avalanches from abrupt melting of ice and permafrost; and elevated ocean temperatures that in turn kill coral reefs that protect seaside hotels from storm surge, shellfish poisoning, transmission of cholera via algal blooms.

In turn, each *individual* event within these mosaics can have multiple insurance consequences. This is seen very prominently in the case of wildfire, which results in both property loss *and* respiratory health problems, and, importantly, major pulses of carbon back into the atmosphere creating an undesirable positive feedback accelerating the driving climate changes. Exhibit 4 shows recently released results correlating the rise in western-U.S. wildfires with regional warming.

Perhaps the greatest climate-related health challenge in the United States is that the combination of more airborne allergens, rising temperatures, greater humidity, more particulate matter from wildfires,¹⁹ and more dust and mold may considerably exacerbate upper respiratory disease (e.g. rhinitis [hay fever], conjunctivitis, sinusitis) and cardiovascular disease (due to reduced oxygen and increased carbon monoxide during fires). We expect up to a 60% increase in key pollens due to the so-called “carbon fertilization” of the atmosphere. Ground-level ozone, exacerbated by warming temperatures in cities is yet another cause of respiratory stress. Cases of asthma, already causing greater impacts than Alzheimer’s disease, can be expected to sharply increase under climate change. The baseline cost of asthma was \$13 billion per year in US alone as of the mid-1990s (half of which are direct healthcare costs). If a 30-percent increase took place in the U.S., the *recurring* incremental cost of \$4 billion/year would be on a par with that of a large hurricane each year.

Natural disasters also have material impacts on *mental* health; the World Health Organization has estimated that as a result of Hurricane Katrina up to 2.5 million people have experienced moderate to severe psychological distress, with 25,000 to 50,000 experiencing persistent problems.²⁰

¹⁹ According to the study, hospital admissions for heart and lung ailments increased significantly at the height of the wildfire season, most notably in Ravalli County. Admissions for respiratory disease went from 8.6 per 10,000 residents in 1999 to 16.4 per 10,000 during the 2000 wildfire season — a 90% increase. Admissions for heart problems went from 22.1 per 10,000 residents to 34.6 — a 57% increase.

²⁰ Epstein, P. and E. Mills (eds), op cit.

Extreme weather events also wreak havoc on healthcare *infrastructure*. Today, more than a year after Hurricane Katrina, there are half as many psychiatric beds available in New Orleans hospitals while the incidence of serious mental health problems doubled.²¹ Today, only 2 of 11 New Orleans hospitals are fully functioning. Disruptions are caused by a combination of factors, including direct damage to healthcare facilities, loss of access, disruption of utilities, and evacuation or immobility of healthcare personnel.

As urban and elderly populations are particularly vulnerable, the increasing shift of populations to cities and the rising average age of Americans will lead to increased vulnerability throughout society.

Yes, those most vulnerable to the health impacts of climate change are the lower-income, elderly, or otherwise disenfranchised populations that are less frequent buyers of insurance. Yet, I believe it is dangerous to be nonchalant about this. First, if our nation becomes more prosperous – as all of us hope – these citizens will join the ranks of the insured or uninsured, as the case may be, in greater numbers. Similarly, the penetration of insurance – particularly life and health insurance – is rising at a very fast pace in the developing world, where many of the climate-related threats to health and life are most acute.

Short of a major epidemic, life insurance losses are not likely to increase significantly as a result of climate change in the U.S. However, losses would rise from current levels and could be quite significant in emerging markets (where U.S. insurers increasingly seek to do business).

In closing this discussion of health implications, I would recognize that many secondary and *nearer-term* health *benefits* arise from reductions in greenhouse gas emissions, e.g. the reduction in air pollution or carcinogens when energy demand is trimmed (especially particulates, ozone, nitrogen oxides, heavy metals, and sulfur dioxide) and other categories of benefits such as reduced roadway injuries and deaths where public transportation is employed.

As is the case with the discussion of property losses, future health trends will be driven by a combination of many factors. Unfortunately, the factors linked with climate change are compounded by other dimensions of human behavior, e.g. settlement in high-risk areas, urbanization, and longer life expectancy. This fact only serves to raise the vulnerability of populations to climate change.

For more information on the health impacts of climate change, I commend you to a comprehensive synthesis of the literature in the health chapter of the 2001 Intergovernmental Panel on Climate Change.²² An updated assessment will be released in 2007.

²¹ Kessler, R.C., S. Galea, R.T. Jones, and H.A. Parker. 2006. "Mental Illness and Suicidality after Hurricane Katrina," *Bulletin of the World Health Organization*, November. See also Associated Press. 2006 "Mental Health Crisis Strains New Orleans." November 8.

²² See http://www.grida.no/climate/ipcc_tar/wg2/348.htm

2. Insurers' knowledge of potential climate change impacts on their business and financial condition, and efforts by insurers to respond to identified concerns

Let us now turn, briefly, to the question of insurers' knowledge of potential climate change impacts and efforts by insurers to respond. With some important exceptions, U.S.-based insurers' knowledge of these impacts is, on average, quite thin, at least as has been publicly disclosed. While the American Insurance Association has recently stated that "...the insurance industry does not have the expertise to evaluate conflicting interpretations of scientific evidence or positions on climate change",²³ a number of individual companies and their CAT modelers have shown considerable initiative in this regard, as noted in our prior publications. I would say that the existing focus is largely limited to the property insurance lines, with little if any attention to the implications for the health and life insurance lines. Even within P&C, the focus is almost singularly on damage to real property. Much less consideration has been given to other lines (e.g. personal auto, marine, business interruption, crop, and liability).

The current emphasis on the impacts of climate change within the insurance community seems to track that of the popular media, which is myopically focused on the large headline-catching events.

One trend that concerns me is the often singular focus on the Atlantic Hurricane issue. First, the North Atlantic basin typically hosts only about 5%-10% of the cyclonic storms and depressions globally. This year's activity in the Atlantic was indeed much lower than last year's, but the numbers were *up* in three of the five *other* ocean basins (Exhibit 5). Perhaps to this group's surprise, the number of storms globally in 2006 (95) was on a par with that of 2005 (with 99 storms), and there were more Category 3-5 storms in 2006 than 2005. Irrespective of whether the trend is up or down, the most important point here is that climate is the *long-term* average of weather, and climate change is associated with more *variability* in weather-related events. Thus, hurricane losses should not be expected to show a smooth trend from year to year.

Large-scale events aside, the other thing that concerns me about the fixation on hurricanes is that aggregate losses from *relatively* small-scale events can have very significant cumulative impacts on insurers as well. There is a litany of types of such events. As an illustration, it's notable that Swiss Re has projected major increases in winter storm activity due to climate change.²⁴ It may come as a surprise to some that catastrophe losses in the first half of 2006 exceeded by almost a factor of two those from 2005.²⁵ I think more attention needs to be paid to these relatively small events.

²³ Ballen, D.T. 2006. "Climate Change & Insurance: Sweeping Regulations are Not The Answer." Washington Legal Foundation, Vol 21., No. 36., Novemer 17, 4pp.

²⁴ Swiss Re. 2006. "The Effects of Climate Change: Storm Damage in Europe on the Rise." Swiss Reinsurance Company, Report 1503160_06_en.

²⁵ Green, M. 2006. "Flirting with Disaster." *Bests Review*, November, p. 62.

And some categories of these small events are themselves evolving *into* catastrophes. Among the “Top-10” potential catastrophe scenarios from RMS are a Western wildfire with \$5 billion in insured losses and a Northeast Ice Storm and Blackout with \$3.6 billion in insured losses.²⁶

A measure of the seemingly limited concern exhibited by primary insurance companies in the U.S. is their low response rate to the annual Carbon Disclosure Project (CDP) surveys, especially as compared to other U.S. industries and to insurers in other countries. The CDP provides a secretariat for the world's largest institutional investor collaboration (\$31 trillion under management) on the business implications of climate change. CDP represents an efficient process whereby many institutional investors collectively sign a single global request for disclosure of information on Greenhouse Gas Emissions. CDP has historically sent this request to the FT500 largest companies in the world, recently expanded to 2100 companies.

As can be seen from Exhibit 6, only 30% of U.S. insurers polled responded to the latest CDP survey as compared with 62% of those domiciled in other countries. A recent study found that SEC disclosure of climate change related risks among publicly-traded insurance companies in the U.S. is very poor, with only 15% of property and casualty insurers reporting.²⁷

I would be remiss if I did not note that a number of insurers can be commended for their initial efforts to respond to climate-change. These are extensively documented in the report entitled “From Risk to Opportunity: How Insurers Can Proactively and Profitably Manage Climate Change,”²⁸ with a sampling given in Exhibit 7. I am submitting that full report to the record for you to examine at your leisure. You will also find there our list of recommended best practices in this realm.

While half of the companies cited in that report were U.S.-based, none had what we would regard as a comprehensive strategy, and most efforts were focused on the worthwhile but longer-term goal of reducing greenhouse gases, while few were focused on nearer term enhancements to disaster resilience.

An insurer that integrates best practices in to its business will implement the following ten-point strategy:

1. Make concerted efforts to restore and maintain the insurability of extreme weather events. This may require partnerships with governments, e.g., in the cases of improved land-use planning and enforced building codes.

²⁶ RMS. 2004. “Risk & Insurance: Top-10 Risks,” Risk Management Solutions, Newark, CA, 24pp (April).

²⁷ Chan-Fishel. 2005. “Fourth Survey of Climate Change Disclosure on SEC Filings of Automobile, Insurance, Oil & Gas, Petrochemical, and Utilities Companies,” Friends of the Earth (September).

²⁸ Mills, E. and E. Lecomte. 2006. “From Risk to Opportunity: How Insurers Can Proactively and Profitably Manage Climate Change.” Published by Ceres, Boston, MA.

2. Improve the modeling and other methods of analyzing risks associated with climate change.
3. Utilize terms and conditions to foster the right decisions by customers. This could range from rewarding risk-minimizing behavior to excluding climate change liabilities for those who make imprudent decisions either as emitters of greenhouse gases or managers of risks associated with climate change.
4. Develop new products and services to facilitate maximum customer utilization of climate-friendly technologies and practices, especially in cases where they yield loss-prevention co-benefits.
5. Invest in strategic R&D and rebalance investment portfolios to (a) recognize climate-related risks to investments and (b) capitalize on opportunities for emerging industries that will participate in climate change solutions.
6. Actively participate in carbon markets, both as investor and risk manager.
7. Lead by example in minimizing the insurer's own "carbon footprint". This includes minimizing the climate impacts of real estate owned by the insurer, as well as the "carbon footprint" of business operations, and by analyzing and disclosing exposures to climate change.
8. Take an active role in the education of customers about climate-related risks and opportunities for minimizing them.
9. Actively engage in public policy discussions about appropriate responses to climate change.
10. Tighten terms and conditions, withdraw from markets, or increase insurance prices only when the aforementioned best practices have first been exercised to their fullest cost-effective potential.

Corollary best practices for rating agencies will involve assessing insurers' handling of climate risks. Other trade allies—such as brokers, agents, and risk managers—can reinforce the aforementioned best practices on behalf of insurance customers.

Insurance trade associations have important roles to play as well. This year, the Insurance Information Institute²⁹ released its first-ever public treatment of the question, which dwelled mostly on their perception of knowledge gaps. The American Insurance Association issued a climate change publication in 1999 (and a four-page cautionary memo to regulators in 2006).³⁰ These documents focus on property-casualty lines, and do not treat the implications of climate change for insurance customers, i.e., availability and affordability, should insurance markets contract. The Institute for Business and Home Safety (IBHS) rarely if ever discusses climate change, but performs important and well-known work on fortifying properties. I am not aware of any U.S.-based insurance associations that have examined the implications of climate change for the life/health lines.

²⁹ Valverde, L.J. Jr. and M.W. Andrews. 2006. "Global Climate Change and Extreme Weather: An Exploration of Scientific Uncertainty and the Economics of Insurance." Insurance Information Institute.

³⁰ AIA. 1999. "Property-Casualty Insurance and the Climate Change Debate: A Risk Assessment." American Insurance Association, Washington, DC. and Ballen *op cit*.

3. Recommendations on steps that regulators could take to assure that they are adequately monitoring insurers' activities with regard to managing the financial condition and performance of insurance markets

My foregoing characterization of the context of the climate change problem is not intended to convey a “gloom-and-doom” or hopeless situation. The risks are real, but so are the opportunities. A small but growing cohort of insurers and reinsurers has made major strides towards constructive solutions that are consistent with their core business objectives. Insurance regulators are essential participants in this process, and the remainder of my remarks are intended to highlight concrete ways in which the NAIC can help maintain the availability and affordability of insurance for customers, while maintaining the financial health of insurers.³¹

As exemplified by the work of the insurer-funded Institute for Business and Home Safety (IBHS) in the U.S. and the Institute for Catastrophic Loss Reduction (ICLR) in Canada,³² there are many strategies for improving the disaster resilience of homes and businesses. The engineering-oriented FM Global has stated that the nearly 500 locations damaged by Hurricane Katrina that had implemented all of their recommended hurricane-loss-prevention methods experienced only one-eighth the losses of those who had not done so.³³ These benefits came at a bargain, with \$500 million in losses avoided via customer investments of only \$2.5 million.³⁴ FM Global had some of the best underwriting results among U.S. insurers during the year of Hurricane Katrina. Other studies have corroborated that mitigation is highly cost-effective.³⁵

But we should remember that the need extends well beyond the buildings sector to include crops, roadway safety, marine settings, and life/health risks. Perhaps with encouragement and support from their regulators, the U.S. insurance industry could put considerably more resources into these endeavors.

³¹ Further discussion of considerations for regulators can be found in Mills E., E. Lecomte, and A. Pears. 2002. “Insurers in the Greenhouse,” *Journal of Insurance Regulation*, Vol 21, No 1., pp. 43-78.

³² Kovacs, P. 2006. “Hope for the Best and Prepare for the Worst: How Canada’s Insurers Stay a Step Ahead of Climate Change.” *Policy Options*, p. 53-56, December/January.

³³ Dankwa, D. 2006. “FM Global Touts Underwriting by Engineering as Superior.” *Best’s Review*, p. 93, June.

³⁴ Green, M. 2006. “Preparing For the Worst.” *Best’s Review*, pp. 40-44, April.

³⁵ Multihazard Mitigation Council. 2006 “Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities.” National Institute of Building Sciences. Prepared for FEMA.

I have identified 12 potential ways in which NAIC can make a constructive contribution towards moving forward, and am happy to offer them here for your consideration. These serve the goals of:

- Analysis and Capacity Building
- Promoting Disaster-Resilience and Loss Prevention
- Maintaining Insurance Availability and Affordability
- Safeguarding Customer Surplus

In pursuing these initiatives, I encourage NAIC to reach out to include insurers themselves who possess considerable knowledge and skill for evaluating and addressing climate risks, as well as local and federal governments, lending institutions, insurance consumer groups, other regulatory bodies (e.g. the SEC), the scientific community, NGOs, and other entities such as energy utilities with an interest in managing the risks of climate change.

1. **Stay current on the science.** Although climate change is one of the more dynamic and rapidly developing areas of science, many commentators refer to decade-old information as “state of the art” typically resulting in overstatement of the uncertainties. Some parties exaggerate *or* ignore uncertainty through selective reporting—although their ranks are thinning. The experience gathered by the NAIC through years of their involvement in the regulation of insurance companies places them in a position to advance suggestions that would shrink the uncertainties that have arisen.

If I may invoke a metaphor, it is critical that policymaking bodies such as NAIC not have their attention focused on the hole in the donut as evidence that there is no donut.³⁶ An example of this could be the statistics on Atlantic Hurricanes, which most people don’t realize represent only 5% of the total number of tropical cyclones in an average year. As I outlined above, a quiet year in the Atlantic does not necessarily mean a quiet year in the world.

For an authoritative synthesis of the peer-reviewed climate literature, I particularly recommend that this Task Force review the 4th Assessment of the Intergovernmental Panel on Climate Change (IPCC), to be released in 2007 by the United Nations.³⁷ The IPCC reports uniquely synthesize the existing scientific literature on climate change and provide summaries for policymakers that are accessible to non-specialist audiences. Several of the chapters in this forthcoming assessment will discuss the relevancy of climate change for insurance.

³⁶ Gleick, P. 2005. “On Truth, Fact, Values, Climate Change, and Doughnuts.” *Environmental Network News*, December 29.

³⁷ The Report of Working Group 1 will be finalized in early February 2007. The Working Group 2 Report will be completed in early April 2007, the Working Group 3 Report in early May 2007 and the Synthesis Report by mid-November 2007. see <http://www.ipcc.ch>

2. **Require that insurers collect and analyze more comprehensive data on weather-related losses and their insurance implications.** The full cost of weather-related insurance losses is *not known*. And, as the old saying goes, “you cannot manage what you don’t measure.” I am particularly concerned by the ways in which the existing floor of \$25 million of insured losses per event understates, skews, and erodes the value of the Property Claim Services data upon which insurers and their regulators heavily rely.³⁸ For example, thanks to this arbitrary cutoff, no winter storms were included in the PCS statistics for the 46-year period from 1949 to 1974, and few were included thereafter.³⁹ Yet, each year these events collectively yield losses in an average year on a par with those of a large hurricane. Relaxing the \$25M limit within PCS, or creating a new data-gathering activity would be of considerable value. While catastrophe losses are relatively well documented, scant information exists for other important “small-scale” events such as lightning strikes, soil subsidence, weather-related vehicle accidents, power outages, and health-related losses. Relevant insurance loss data should be more readily available in the public domain and to the scientific community, preferably at no cost (which is currently not the case).

My own research has been confounded by the lack of readily available data on U.S. insurers insurance premiums, exposures, and losses for the business they do *outside* the U.S. This information is much needed, as most climate-change risks are located in the emerging markets where many U.S. insurers are looking for growth.

Lastly on this item, I know of no comprehensive database on insurance policy cancellations or other indicators of changes in insurance availability. In one of our recent reports⁴⁰ we had to manually assemble snippets of information from news reports and other “grey literature,” which no doubt yielded an underestimate of the full scope of the problem.

Anti-trust laws could serve to be an unintended barrier in this regard, a problem that NAIC should take a leadership role in resolving.

3. **Raise the standards of practice for catastrophe modeling and create a non-proprietary modeling and data-collection entity.** In order to assess exposures of insurers and their customers, CAT models should integrate the processes of climate change. RMS has begun to do so this year, and I believe that AIR is close behind, but there is much more work to do. The models and their embedded assumptions should be subject to peer review—by an appropriately composed

³⁸ According to the Insurance Information Institute, when the floor was raised from \$5M in 1996 to \$25M in 1997, the number of catastrophes fell from 41 in 1996 to 25 in 1997, mostly due to this reclassification. See <http://www.iii.org/media/hottopics/insurance/xxx/>

³⁹ K. E. Kunkel, R. A. Pielke Jr., S. A. Changnon. “Temporal Fluctuations in Weather and Climate Extremes That Cause Economic and Human Health Impacts: A Review.” *Bulletin of the American Meteorological Society* 80, 1077 (1999).

⁴⁰ Mills, E. 2006. *op cit*.

team—and validation, and should be transparent to regulators. Regulators should not be expected to do this in-house. To my knowledge, the Florida Commission on Hurricane Loss Projection Methodology is the only state that has a formal system for vetting models.⁴¹

Existing CAT models, however, only cover a subset of insurance-relevant climate change impacts. For example, implications for life/health lines are barely if at all captured in current models. These voids should be filled with new modeling methods or supplemental tools.

New uses should also be sought for CAT models. An important, albeit antiquated, example was the All-Industry Research Advisory Council's (AIRAC) report in 1986, which surprised the insurance community by quantifying a previously unrecognized effect of multiple mega-catastrophes on insurer solvency.⁴² This work has not been replicated or updated over the intervening 20 years. Another area that merits analysis is the degree to which insurer investments may unexpectedly decline in value if they have not been thoroughly vetted for climate risk issues. As U.S. insurers do more and more business overseas, regulators must assess those risks—which will be vastly higher than those in the U.S.

Modeling and data are a public good, and creating a new public-domain activity to do so could improve economic efficiency by reducing redundant expenditure by individual insurers and make life easier for regulators who now have to individually vet models. There are enormous opportunities to build better bridges between the extensive scientific community analyzing climate risks and solutions, and those working in insurance and the actuarial sciences. Such an entity could, for example, replicate the aforementioned AIRAC study to gain better insight into the relationships between climate change and insurer solvency. Insurers would logically co-fund the entity, but oversight would be by NAIC or some other public entity. This activity could prove very helpful in implementing a number of the other recommendations I am making today. There would no doubt continue to be a complementary role for the CAT modeling industry.

4. **Add climate-change interrogatories to the statutory annual statement in response to the need for public disclosure of insurer risk analysis of climate change.** NAIC should develop template language for inviting insurers to articulate their efforts to understand and manage climate-change risk as part of the statutory annual statement. NAIC recently modified the Annual Statement to include disclosures regarding ethics in response to Sarbanes Oxley and incidents involving specific companies.⁴³ A similar action is appropriate regarding climate

⁴¹ See <http://www.sbafla.com/methodology/>

⁴² AIRAC. 1986. "Catastrophic Losses: How the Insurance System Would Handle Two \$7 Billion Hurricanes." All-industry Research Advisory Council (available from the American Institute for CPCU, Insurance Institute of America, Insurance Research Council, Malvern PA, USA), 73 pp.

⁴³ National Association of Mutual Insurance Companies. News Release. "New Interrogatory for Quarterly, Annual Statements Seeks Ethics Disclosure from Senior Management," November 21, 2006.

change. It should be noted that the existing climate disclosure activities (e.g. the Carbon Disclosure Project) tend to be targeted towards investor-owned companies; NAIC should also include other categories of insurers such as the mutual companies.

5. **Promote the development of climate friendly insurance products and premium incentives through model laws and/or regulations.** NAIC should adopt model laws for state legislators and/or insurance regulators, whose job it is to ultimately adopt them. An example would be to call for separate rating of hybrid vehicles, keep track of loss experience, and ultimately utilize the results to propose differential treatment of customers owning these cars. Insurers should provide differentiated premiums, financial incentives, or financing to encourage risk-reducing behavior. Barriers to these activities should be proactively identified and remedied. Insurers interviewed by the Iowa Department of Natural Resources cited difficulties in gaining regulatory approval for premium credits as a key barrier to promoting climate change responses.⁴⁴ State insurance regulators are operating in a new era with respect to climate change and it is therefore necessary for them to make a special effort to encourage insurers and insurance consumers to make sound recommendations that can quickly be considered by regulators.
6. **Require actuarial pricing of risks based on improved understanding of climate-related risks in combination with insurer accountability and attention to availability and affordability issues.** Poorly differentiated premiums do not send the desired signals. In an example that is literally near to home, I live on the edge of a wildland-urban interface in California, yet pay the same fire premiums as much less at-risk houses in my area. More actuarial (or “risk-based”) pricing certainly raises issues of affordability, but also can be geared to encourage better behavior (e.g. managing fuel loads around structures). NAIC should ensure that underwriting decisions are based on an intent for long-term market participation. Contexts deemed uninsurable should be treated as such, so that insurance does not inadvertently encourage maladaptation to climate change.

With the preceding processes in place, ratemaking and the setting of other terms and conditions would send the correct signals to insureds. Rates based rigidly on past experience are at odds with the science, but the need to avoid unsubstantiated increases is also real. Rates should send clearer signals as to the climate- and weather-related risks faced by consumers, and could function more effectively than at present in fostering risk-reducing behavior. This said, I do not believe that the problems now being seen in the market can be simply blamed on rate regulation. It is clear in the aftermath of Hurricane Katrina that unregulated surplus, commercial, and energy industry insurance lines—as well as unregulated reinsurers—had severe problems as well, as evidenced by Florida’s recent

⁴⁴ IDNR. 2000. “Insurance Industry Participation in Promotion of Building Energy Codes.” Prepared by the Center for Business and Economic Research, Louisiana State University, for Iowa Department of Natural Resources, August.

creation of a Joint Underwriting Association to deal with commercial insurance.^{45,46} I should say, however, that while risk-based pricing is important, it alone is no panacea for our growing climate woes.

7. **Take the lead on a coordinated national effort to improve disaster-resilience through the adoption, enforcement, and implementation of improved building code.** Improved building codes are one of the key strategies, and their benefits have been well documented. Burby's post-Katrina analysis revealed that per-capita catastrophe losses were three-times lower in areas where building codes and comprehensive land-use planning were in use.⁴⁷ To be effective, building codes must be enforced. The Insurance Services Office Building Code Effectiveness Grading Scale⁴⁸ has been used to reward effective codes via insurance discounts or surcharges. However, evidence unfortunately abounds on the disconnect between codes and practice. Regulator efforts to support training and enforcement would help improve the efficacy of codes. There are usually ample opportunities to go beyond code, and NAIC could play a role in that respect as well.
8. **Promote "Rebuilding Right" following losses.** Insurers can promote risk-prevention strategies in the context of rebuilding after losses.⁴⁹ "Rebuilding Right" in the aftermath of Hurricane Katrina is an immediate opportunity, which could involve everything from wetlands restoration to safer buildings. The flip side of this coin is that following losses, properties should only be insured again if they meet appropriate standards. Insurers can facilitate this with financial incentives/signals, and perhaps direct customer financing of upgrades. I would like to stress that there are many opportunities for *simultaneously* securing near-term enhancements in disaster resilience while contributing to reduced greenhouse-gas emissions for the long term (Exhibit 8).⁵⁰ A subset of these measures can directly enhance disaster resilience,⁵¹ e.g., the ability of facility-integrated solar power systems to avert business interruptions following outages on the electricity grid or the resistance of foam insulation (as opposed to less-efficient fiber-based products) to water-logging after floods.⁵² Without the latter strategic measures, nearer term tactical measures will only largely serve to defer

⁴⁵ Ruquet, M.E. 2006. "Florida Property Market Crisis Growing," *National Underwriter Property & Casualty*, August 7, p. 6.

⁴⁶ For more on this, see discussion in Mills 2006, p. 10.

⁴⁷ Burby, R.J. 2006. "Hurricane Katrina and the Paradoxes of Government Disaster Policy," *Annals of the American Academy of Political and Social Science*, March.

⁴⁸ Initiated by the Insurance Institute for Property Loss Reduction (IIPLR), under the leadership of Eugene Lecomte.

⁴⁹ Parker, D. 2005. "Post-Hurricane Opportunities." *Home Energy*, March/April, p. 24-27.

⁵⁰ Mills, E. 2003. "The Insurance and Risk Management Industries: New Players in the Delivery of Energy-Efficient Products and Services." *Energy Policy* 31:1257-1272.

⁵¹ Mills, E. 2006. "Synergisms between Climate Change Mitigation and Adaptation: An Insurance Perspective," *Mitigation and Adaptation Strategies for Global Change*, Special Issue on Challenges in Integration Mitigation and Adaptation Responses to Climate Change. (in press)

⁵² Wendt, R. and H. Aglan. 2004. "After The Flood—There's Hope: Homes that are damaged by flooding can be repaired and made more durable." *Home Energy*, September/October, pp. 18-23.

rather than avoid the ultimate consequences of climate change. Fireman's Fund is offering insurance terms that encourage rebuilding to meet current "green construction" standards, some facets of which also make buildings more disaster-resilient.

9. **Promote partnerships with policyholders for loss mitigation.** Examples include insurer loans for building retrofit paid for with loss mitigation discounts. There is a huge need for better consumer education and information. The insurer-funded Institute for Business and Home Safety is engaged in such activity for some property-casualty lines, but at a very modest level given the need. Their "Fortified... for safer living" guidelines provide one framework for identifying eligible measures. Insurers of course have pre-existing and regular (quarterly or semi-annual) correspondence with customers, providing a ready channel for transmitting loss-prevention information.⁵³ One of many examples of information that could be conveyed is the USEPA's Excessive Heat Events Guidebook.

Allianz has reviewed examples from many countries.⁵⁴ In 2004, the Insurance Australia Group (IAG) developed a partnership with local government planners in New Zealand to determine the most appropriate flood planning levels for the future. IAG provided modeling results indicating changes in extreme rainfall, which the local government used to determine the likely changes to future flood levels. This was then incorporated into their flood mitigation program, e.g., planning for higher levee banks. IAG also conducts wind and hail-related research intended to help improve roof designs and construction.⁵⁵ In the UK, the Association of British Insurers has also advised local planning authorities on better integrating rising flood risks in East London.⁵⁶ In the U.S., AIG is serving on the steering committee of the Heinz Center's "The Nation's Coasts: A Vision for the Future", which seeks to create a more viable approach to sustainability for coastal communities and surrounding regions.

10. **Safeguard surplus based on understanding of climate change, and encourage prudent investments in technologies and industries that will be part of the solution.** One way to accomplish this is to revise risk-based capital requirements to provide credits for "climate friendly" investments, including carbon trading. Effectively, a dollar invested in climate-friendly investment is weighted higher, which means insurers investing in these new directions enjoy a higher ROE for a given level of revenues because the overall required level of capital is lower. Climate change brings huge new opportunities for investors. Legendary venture capitalist John Doerr has called clean technology "the largest economic

⁵³ See <http://www.epa.gov/heatisland/about/heatguidebook.html>

⁵⁴ Dlugolecki and Lafeld. 2005. op. cit.

⁵⁵ Stagnitta, L. and K. Forster. 2005. "Is Climate Change for Real and if so What is the Cause, Likely Impact, and Remedy?" *Proceedings of the Australian Building Codes Board National Conference*, Insurance Australia Group.

⁵⁶ Association of British Insurers. 2005. "East London Sub-Regional Development Framework: Consultation." July.

opportunity of the 21st century.” Conversely, investments in polluting industries are likely to become more risky.

11. Encourage or require insurers to minimize their own carbon footprint.

Leadership by example is important both symbolically and practically. Some insurers already participate in the national ENERGY STAR Program and other initiatives to trim energy use and greenhouse-gas emissions in their own operations. One U.S. insurance broker has already gone carbon-neutral in its operations. Managing energy use and trimming energy expenditures is also in the interest of shareholders and customers.

12. Communicate industry needs and priorities to federal and local governments with lead responsibility for implementation.

These range from updating antiquated flood plain maps, to performing climate change research, to implementing appropriate public-health measures, to reducing the emissions of greenhouse gases. Many of the solutions require improved public/private partnerships between insurers, other segments of the private sector, and local/federal government. As an example, the American Insurance Association offered six such recommendations to the OECD for mitigating catastrophe risk.⁵⁷ These included early warning systems, better land-use planning, improved building codes and catastrophe-resistant reconstruction, improved coordination and planning of national and international relief efforts, assistance in catastrophe contingency planning, and support for pre- and post-event mitigation and response.

Lastly, in a closing suggestion that would likely prove beneficial in pursuing all of the aforementioned recommendations, I would encourage NAIC, through its international activities, to seek audiences with insurance regulators in other countries to learn how they have responded to the climate change issue.

* * *

In closing, I would say that insurance is a form of adaptive capacity for the impacts of climate change, although the sector itself must adapt in order to remain viable. Managing risks and controlling losses is central to the insurance business, and is evident in the industry’s early history. While the primary focus in recent years has been on *financially* managing risks (through exclusions, price increases, alternative risk transfer, etc.), *physical* risk management is rightfully receiving renewed attention from insurers and yourselves, and could play a large role in helping to preserve the insurability natural hazards.

Improved building codes and land-use management are important starting points. Beyond that, useful innovations include a whole genre of energy-efficient and renewable energy

⁵⁷ AIA. 1999. *Property-Casualty Insurance and the Climate Change Debate: A Risk Assessment*. American Insurance Association: Washington D.C.
(<http://www.aiadc.org/media/press/april/pr41999cas.htm>)

technologies that also make infrastructure less vulnerable to near-term insured losses. Improved management of forests, agriculture and wetlands also offers dual benefits, i.e. withdrawal of carbon from the atmosphere and storage in biomass and soils coupled with increased resilience to drought, coastal erosion, and other products of weather extremes.

I again thank you for the opportunity to address this group

Evan Mills, Ph.D.

Biographical Information: I have worked in the energy and environment field for over twenty years, primarily at the U.S. Department of Energy's Lawrence Berkeley National Laboratory, which is managed for DOE by the University of California. For the past decade I have studied in depth the question of the impacts of climate change on the insurance industry, both in the U.S. and abroad. I served as co-leader of the World Meteorological Organization and UN Environment Program's Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report's chapter on insurance, and am contributing to the Fourth Assessment due for release in 2007. I have published over 50 reports and articles on the topic, including a recent synthesis in the journal *Science*.⁵⁸

In the course of this work, I have had the privilege of working with many members of the insurance industry and trade associations, including, among others Eugene Lecomte, President Emeritus of the Institute for Business and Home Safety and Richard Roth Jr., former Chief Property and Casualty Actuary for the Department of Insurance, State of California. Richard also served as Chairman of the Casualty Actuarial (Technical) Task Force at the NAIC, and was active on the two catastrophe insurance committees addressing catastrophe insurance issues for insured natural disasters. With these two individuals, I co-authored two studies focusing on the U.S. situation previously presented to NAIC audiences. These are entitled: "The Availability and Affordability of Insurance Under Climate Change" and "From Risk to Opportunity: How Insurers Can Proactively and Profitably Manage Climate Change." I also served as co-editor of the Climate Change Futures Study,⁵⁹ led by Dr. Paul Epstein at the Harvard Medical School and sponsored by Swiss Re.

More on my insurance research can be found at <http://eetd.lbl.gov/insurance>

⁵⁸ Mills, E. 2005. "Insurance in a Climate of Change," *Science* Vol. 308:1040-1044. 12 August.

⁵⁹ Epstein, P. and E. Mills (eds.). 2005. "Climate Change Futures: Health, Ecological and Economic Dimensions." Published by Harvard Medical School, sponsored by Swiss Re and the U.N. Development Programme. Contributing Authors: P. Anderson, J. Brownstein, U. Confalonieri, D. Causey, N. Chan, K. L. Ebi, J. H. Epstein, J. S. Greene, R. Hayes, E. Hofmann, L. S. Kalkstein, T. Kjellstrom, R. Lincoln, A. J. McMichael, C. McNeill, D. Mills, A. Milne, A. D. Perrin, G. Ranmuthugala, C. Rogers, C. Rosenzweig, Colin L. Soskolne, G. Tabor, M. Vicarelli, X.B. Yang.

EXHIBIT 1. Examples of impacts resulting from projected changes in extreme climate events, and associated insurance implications (Adapted from IPCC/Vellinga et al., 2001)

Projected Changes during the 21st Century in Extreme Climate Phenomena	IPCC Assessment of Change Likelihood ^a	Representative Examples of Projected Impacts ^b	Peril or Hazard	Insurance-sector Impacts ("+" = increased losses "-" = reduced losses)							Insurance Customer Impacts		
				Property (structures; industrial)	Property (autos/marine/aircraft)	Liability: Business Interruption	Crop	Health	Life	Public Insurance/Assistance	Pricing	Exclusions	Availability
Higher maximum temperatures; more hot days and heat waves ^d over nearly all land areas	Very Likely	Increased hospitalizations over broad demographic range; incidence of death and serious illness in older age groups and urban poor	Heatwave					+	+	+			
		Increased heat stress in livestock and wildlife	Heatwave				+			+			
		Increased risk of damage to a number of crops	Heatwave				+			+			
		Increased soil subsidence	Subsidence	+		+				+			
		Decreased ice in northern maritime shipping lanes	Float ice		-								
		Increased roadway accidents (slower reaction time)	Road conditions		+								
		Increased electric cooling demand and reduced energy supply reliability	Power Outage			+				+			
Higher (increasing) minimum temperatures; fewer cold days, frost days, and cold waves over nearly all land areas	Very Likely	Decreased cold-related human morbidity and mortality	Coldwave					-	-	-			
		Decreased risk of damage to a number of crops, and increased risk to others	Heatwave				-			-			
		Extended range, reproduction, and activity of some pest (e.g. pine beetle) and disease vectors	Infestation	+		+	+	+	+	+			
		Increased avalanche risk	Avalanche	+		+							
		Increased permafrost melt	Subsidence	+		+				+			
		Increased incidence of lightning	Lightning	+	+	+	+			+			
More intense precipitation events (Very Likely ^e over many areas)	Very Likely, over many areas	Increased flood, landslide, avalanche, and mudslide damage	Flood, landslide, avalanche, mudslide	+	+	+				+			
		Increased soil erosion; mudslides	Rain							+			
		Increased flood runoff could increase recharge of some floodplain aquifers	Flood				-			-			
	Likely	Increased roadway accidents (driving conditions, visibility)	Road conditions		+			+	+				
		Decreased crop yields	Drought				+			+			
		Increased damage to building foundations caused by ground shrinkage	Subsidence	+									
		Decreased water resource quantity and quality	Drought			+	+	+		+			
Increased summer drying over most mid-latitude continental interiors and associated risk of drought	Likely	Increased risk of wildfire	Wildfire	+	+	+	+	+	+	+			
		Increased risks of property damage, business interruption, loss of human life, infectious disease epidemics	Wind, disease	+	+	+	+	+	+	+			
		Increased coastal erosion and damage to coastal buildings and infrastructure [tidal surge insured under NFIP]	Tidal surge							+			
		Increased damage to coastal ecosystems such as coral reefs and mangroves	Tidal surge	+	+	+	+	+	+	+			
Intensified droughts and floods associated with El Niño events in many different regions	Likely	Decreased agricultural and rangeland productivity in drought- and flood-prone regions	Drought				+			+			
		Decreased hydro-power potential in drought-prone regions	Drought			+				+			
Increased intensity of mid-latitude storms ^d	Little agreement between current models as of 2001. Subsequent research (Knutson/Trenberth/MIT/ABI) has shown increased likelihood of hurricane damages	Increased risks to human life and health	Storm					+	+	+			
		Increased property and infrastructure losses	Storm	+	+	+	+			+			
		Increased damage to coastal ecosystems, including loss of mangroves and coastal wetlands	Storm	+	+	+				+			

a Likelihood refers to judgmental estimates of confidence used by Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report (TAR), Working Group I: very likely (90-99% chance); likely (66-90% chance). Unless otherwise stated, information on climate phenomena is taken from the IPCC Summary for Policymakers, TAR WGII.

b These impacts can be lessened by appropriate response measures.

c Based on information from chapters in the IPCC Third Assessment Report; high confidence refers to probabilities between 67 and 95% as described in Footnote 6 of TAR WGII, Summary for Policymakers.

d Information from IPCC Third Assessment Report, Working Group I, Technical Summary, Section F.5.

e Changes in regional distribution of tropical cyclones are possible but have not been established.

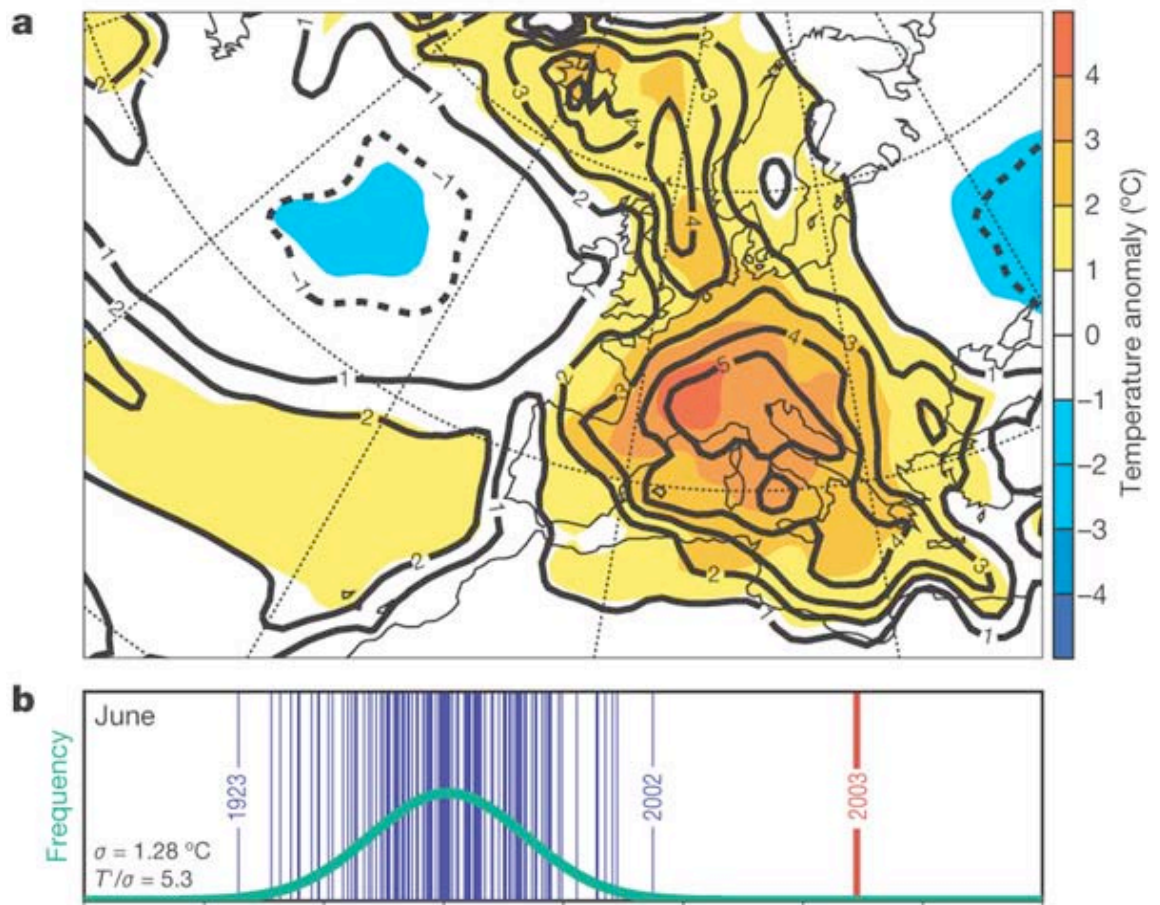


EXHIBIT 2. Departures from normal temperatures during the Great European Heatwave of 2003. (a) June-August temperature anomaly with respect to the 1961–90 mean. Color shading shows temperature anomaly (degrees C), bold contours display anomalies normalized by the 30-yr standard deviation. (b) Distribution of Swiss monthly and seasonal summer temperature for 1864–2003. The fitted Gaussian distribution is indicated in green. The values in the lower left corner are the standard deviation and the 2003 anomaly normalized by the 1864–2000 standard deviation. Source: Schar et al, 2004, in *Nature*.

EXHIBIT 3. Health Implications from the Climate Change Futures (CCF) Study

Infectious & Respiratory Diseases

- **Malaria** is the deadliest, most disabling and most economically damaging mosquito-borne disease worldwide. Warming affects its range, and extreme weather events can precipitate large outbreaks. The CCF study documents the fivefold increase in illness following a six-week flood in Mozambique, explores the surprising role of drought in northeast Brazil, and projects changes for malaria in the highlands of Zimbabwe.
- **West Nile virus (WNV)** is an urban-based, mosquito-borne infection, afflicting humans, horses and more than 138 species of birds. Present in the US, Europe, the Middle East and Africa, warm winters and spring droughts play roles in amplifying this disease. To date, there have been over 17,000 human cases and over 650 deaths from WNV in North America.
- **Lyme disease** is the most widespread vector-borne disease in the US and can cause long-term disability. Lyme disease is spreading in North America and Europe as winters warm, and models project that warming will continue to shift the suitable range for the deer ticks that carry this infection.
- **Asthma** prevalence has quadrupled in the US since 1980, and this condition is increasing in developed and underdeveloped nations. New drivers include rising CO₂, which increases the allergenic plant pollens and some soil fungi, and dust clouds containing particles and microbes coming from expanding deserts, compounding the effects of air pollutants and smog from the burning of fossil fuels.

Extreme Weather Events

- **Heat waves** are becoming more common and more intense throughout the world. The CCF study explores the multiple impacts of the highly anomalous 2003 summer heat wave in Europe and the potential impact of such “outlier” events elsewhere for human health, forests, agricultural yields, mountain glaciers and utility grids.
- **Floods** inundated large parts of Central Europe in 2002 and had consequences for human health and infrastructure. Serious floods occurred again in Central Europe in 2005. The return times for such inundations are projected to decrease in developed and developing nations, and climate change is expected to result in more heavy rainfall events.

Health Impacts in Natural and Managed Systems

- **Forests** are experiencing numerous pest infestations. Warming increases the range, reproductive rates and activity of pests, such as spruce bark beetles, while drought makes trees more susceptible to the pests. The CCF study examines the synergies of drought and pests, and the dangers of wildfire. Large-scale forest diebacks are possible, and they would have severe consequences for human health, property, wildlife, timber and Earth’s carbon cycle.
- **Agriculture** faces warming, more extremes and more diseases. More drought and flooding under the new climate, and accompanying outbreaks of crop pests and diseases, can affect yields, nutrition, food prices and political stability. Chemical measures to limit infestations are costly and unhealthy.
- **Marine ecosystems** are under increasing pressure from over-fishing, excess wastes, loss of wetlands, and diseases of bivalves that normally filter and clean bays and estuaries. Even slightly elevated ocean temperatures can destroy the symbiotic relationship between algae and animal polyps that make up coral reefs, which buffer shores, harbor fish and contain organisms with powerful chemicals useful to medicine. Warming seas and diseases may cause coral reefs to collapse.
- **Water**, life’s essential ingredient, faces enormous threats. Underground stores are being overdrawn and underfed. As weather patterns shift and mountain ice fields disappear, changes in water quality and availability will pose growth limitations on human settlements, agriculture and hydropower. Flooding can lead to water contamination with toxic chemicals and microbes, and natural disasters routinely damage water-delivery infrastructure.

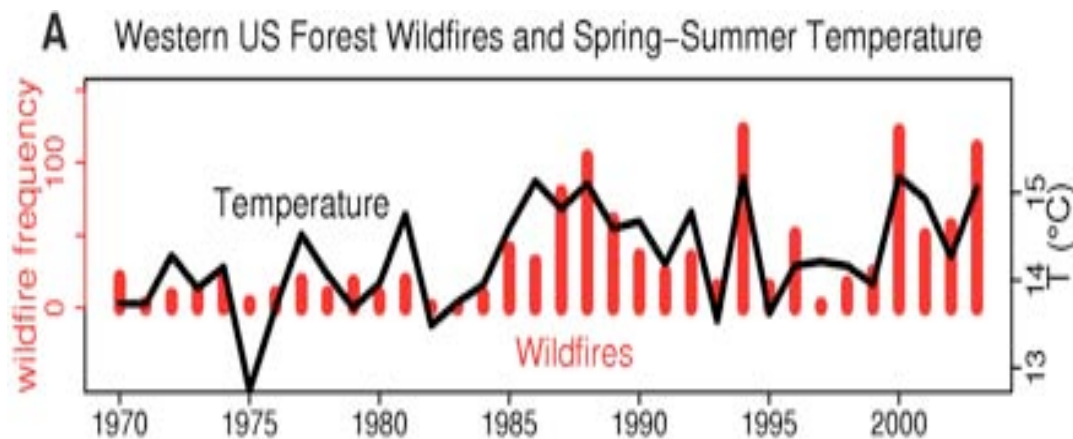


EXHIBIT 4. In the past decade, wildfires in the American West have increased by 4-fold in number and 6-fold in area burned, with the trend very tightly correlated with rising temperatures. The problem is exacerbated by other climate factors such as earlier snowmelt and longer fire seasons. Changes in forest management do not explain the trends. Source: Westerling et al., 2006, in *Science*



Southern California, October 25, 2003

Exhibit 5. Worldwide Hurricanes 2005 & 2006

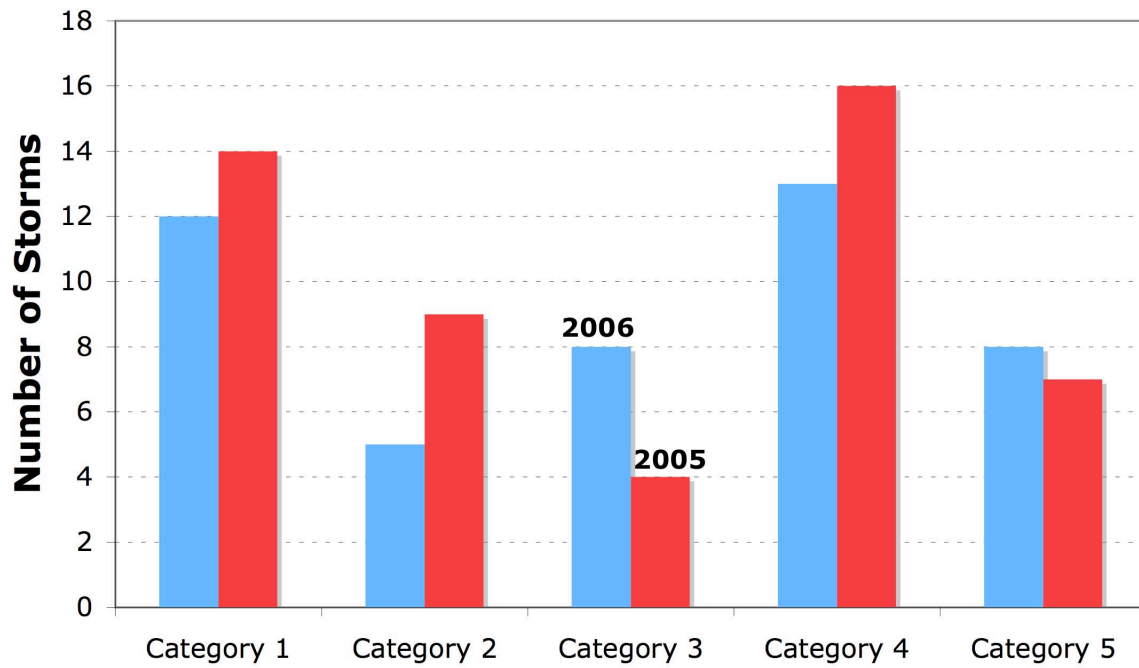


Exhibit 6. Insurance sector responses to the Carbon Disclosure Project surveys.

Insurance Company - USA					Insurance Company - Other						
		2006	2005	2004	2003			2006	2005	2004	2003
ACE	USA	0	-	✓	0	Admiral Group	UK	✓	-	-	-
Aflac	USA	X	0	X	0	Aegon	Netherlands	✓	i	0	X
Allstate	USA	0	X	X	✓	AGF	France	✓	✓	-	-
Ambac Financial Group	USA	0	-	-	-	Allianz	Germany	✓	✓	✓	✓
American International Group	USA	✓	✓	✓	✓	AMB Generali Holding AG	Germany	0	-	-	-
Aon	USA	✓	-	-	i	Amlin	UK	X	-	-	-
Berkshire Hathaway	USA	0	0	X	0	AMP Limited	Australia	✓	-	-	-
Chubb	USA	X	i	0	X	April Group*	France	0	-	-	-
Cincinnati Financial	USA	i	-	-	-	Aviva	UK	✓	✓	✓	✓
Hartford Financial Services	USA	i	X	X	X	AXA Asia Pacific Holdings Limited - AXA Group	Australia	✓	-	-	-
Jefferson-Pilot	USA	0	-	-	-	AXA Group	France	✓	✓	✓	✓
Lincoln National	USA	X	-	-	0	AXA Konzern AG - AXA Group	Germany	✓	-	-	-
Loews Corporation	USA	0	-	X	0	Benfield Group	UK	0	-	-	-
Marsh & McLennan	USA	✓	✓	0	-	Brit Insurance Holdings	UK	0	-	-	-
MBIA	USA	✓	-	-	-	Cathay Financial Holding	Taiwan	✓	✓	✓	-
Metlife	USA	X	0	0	0	Catlin Group LD Coms	UK	i	-	-	-
Progressive	USA	X	X	X	X	China Life Insurance	China	✓	-	-	-
Prudential Financial	USA	X	X	X	X	Cnp Assurances	France	✓	-	-	-
Safeco	USA	✓	-	-	-	E-L Financial	Canada	0	-	-	-
St. Paul Travelers	USA	✓	✓	✓	0	Euler Hermes	France	✓	-	-	-
Torchmark	USA	0	-	-	-	Fairfax Financial Holdings	Canada	0	-	-	-
UnumProvident	USA	✓	-	-	-	Friends Provident	UK	✓	-	-	-
XL Capital	USA	0	X	✓	X	Generali	Italy	i	X	X	X
						Great West Lifeco	Canada	X	0	X	-
						Hannover Ruckversicherung AG	Germany	✓	-	-	-
						Helphire Group	UK	0	-	-	-
						Hiscox	UK	✓	-	-	-
						Hub International	Canada	X	-	-	-
						Industrial Alliance Insurance	Canada	X	-	-	-
						Insurance Australia Group Limited	Australia	✓	-	-	-
						Kingsway Financial Services	Canada	0	-	-	-
						Legal and General	UK	✓	-	-	-
						Manulife Financial	Canada	✓	✓	i	i
						Millea Holdings	Japan	✓	✓	✓	-
						Mitsui Sumitomo Insurance	Japan	✓	✓	-	-
						Munich Re	Germany	✓	✓	✓	✓
						Nipponkoa Insurance Co Ltd	Japan	0	-	-	-
						Nürnbergger Beteiligungs-AG	Germany	X	-	-	-
						Ping An Insurance*	China	0	-	-	-
						Promina Group Limited	Australia	X	-	-	-
						Prudential plc	UK	✓	✓	✓	✓
						Qbe Insurance Group Limited	Australia	X	-	-	-
						RAS	Italy	✓	✓	✓	✓
						Resolution	UK	✓	-	-	-
						Royal & Sun Alliance	UK	✓	-	-	-
						Scor	France	✓	-	-	-
						Sompo Japan Insurance	Japan	✓	-	-	-
						Sun Life Financial	Canada	✓	✓	X	X
						Swiss Re	Switzerland	✓	✓	✓	✓
						T&D Holdings	Japan	✓	-	-	-
						Tower Ltd	New Zealand	0	-	-	-
						Zurich Financial Services	Switzerland	✓	✓	✓	0

Key & Stats for 2006:						
Surveyed		US-N	US%	Other-N	Other-%	
Answered Questionnaire	✓	23	7	30%	32	62%
Declined to Participate	X	6	26%	7	13%	
Provided Information	i	2	9%	2	4%	
No Response	0	8	35%	11	21%	
Not in given round of CDP	--					

Source: <http://www.cdproject.net>

* = had promised a reply, but none submitted

Key & Stats for 2006:		US-N	US%	Other-N	Other-%
Surveyed		23		52	
Answered Questionnaire	✓	7	30%	32	62%
Declined to Participate	X	6	26%	7	13%
Provided Information	i	2	9%	2	4%
No Response	0	8	35%	11	21%
Not in given round of CDP	--				

Source: <http://www.cdproject.net>

* = had promised a reply, but none submitted

EXHIBIT 7. Types of opportunities for insurers and selected examples.		
Type of Activity	Insurance Industry Participant	Description
Promoting Loss Prevention		
Traditional risk management	Institute for Business and Home Safety	Promoting best practices for hazard resistance in buildings through its "fortified ... for safer living" program
Integrating energy management and risk management	FM Global	Replaced fire-hazardous halogen light fixtures in student dorms at Northeastern University with ENERGY STAR fluorescent fixtures, achieving 75% lighting energy savings while eliminating the fire hazard.
Better management of forestry, agriculture, and wetlands	Tokio Marine	Mangrove protection
"Rebuilding Right" following losses	Fireman's Fund	Forthcoming products to pay for post-loss reconstruction upgrades to "green" building standards and commissioning to ensure energy savings
Crafting Innovative Insurance Products and Services		
New products for energy service providers	Locton Risk Services	Group property and liability insurance for RESNET-member building energy auditors
Energy savings insurance	Lloyds of London	Insurance for predicted energy savings or renewable energy technology performance
Renewable energy project insurance	Munich Re	Geothermal exploration risk insurance
Green-buildings insurance	Fireman's Fund	Forthcoming products to provide premium credits for green building features
Pay-as-You-Drive insurance	GMAC	Mileage-based insurance discounts for customers using OnStar global positioning systems
Climate risk management services	AIG/Solomon Associates	Range of services for identifying carbon-reduction opportunities and risks
Participating in Carbon Markets		
Facilitating carbon trading	Aon	Assessment of risks associated with participating in carbon trading markets
Managing risk for Clean-Development Mechanism (CDM) projects	Swiss Re	Kyoto-CDM Risk Insurance
Enabling customers to purchase carbon offsets	Insurance Australia Group	Web-based calculator with option to purchase offsets to compensate for passenger car emissions.
Aligning Terms and Conditions with Risk-Reducing Behavior and Capitalizing on the "Halo Effect"		
Assigning Directors & Officers liability	Swiss Re	Indications that the company may exclude climate change impacts from policies
The "Halo Effect"	Travelers	10% insurance premium credit to drivers of the Toyota Prius hybrid passenger car.
R&D and Direct investment in Climate Change Solutions		
Research & Development	Allstate	Roofing Industry Committee on Wind Issues, working to analyze the mechanisms of roof failures during windstorms.
Investments	Swiss Re	Investment in new solar photovoltaic technology
Climate-responsive funds	Gerling	"Gerling Select 21" fund
Building Awareness and Participating in the Formulation of Public Policy		
Consumer information and education	USAA Insurance Company	Published a detailed guide to energy efficiency for homeowners, including do-it-yourself audit tool and cost-benefit worksheets.
Having a voice in public policy discussions on climate change	UNEP Finance Initiative	Insurers from around the world participating in climate change policy deliberations
Endorsing voluntary energy-saving policies	American Insurance Association	Advocacy for reduced speed limits, public transportation, and telecommuting as means for reducing driving-related insurance claims and greenhouse gas emissions by saving energy
Energy-efficiency codes and standards	Insurance Institute for Highway Safety	First insurance organization to support the stalled Corporate Average Fuel Economy (CAFE) standards, citing new technologies to improve fuel economy without compromising safety through reduced vehicle weight
Leading by Example		
In-house energy management	AIG/Hartford Steam Boiler	The headquarters of Hartford Steam Boiler (now a subsidiary of AIG) was among the first buildings to receive the ENERGY STAR label for superior energy efficiency.
Reducing insurers's carbon footprint through improved operations	American Modern Insurance Group	Utilized solar-powered trailers to expedite claims handling in post-disaster situations where the electrical grid is not functional
Disclosing climate vulnerabilities and liabilities	Saint Paul Travelers	Provided submissions on climate change vulnerability and opportunities to the Carbon Disclosure Project

Source: Mills, E. 2006. "From Risk to Opportunity," Published by Ceres.

EXHIBIT 8. Characterization of climate-change adaptation-mitigation co-benefits, and insurance lines of business effected.

SECTOR > Strategy	MITIGATION BENEFIT	ADAPTATION BENEFIT	TYPES OF INSURANCE BENEFITS
Energy Sector -- Demand Side			
Energy efficiency generally	reduced energy use	grid reliability	business interruption, contingent business interruption, service interruption, boiler and machinery, loss of perishable products
Natural ventilation; daylighting	reduced energy use	allows continued facility occupancy during power outage	business interruption
Insulated ceilings in cold climates	reduced heating energy	structural integrity and extended habitability of structures during natural disaster	property, business interruption
Concrete-polystyrene wall systems	reduced heating and cooling energy use	resistent to wind and water damage	property, life/health, mold liability
Heat island mitigation, e.g. via reduced roof albedo and urban forestry	reduced cooling energy use	extended habitability of structures during heat waves; moderation of precipitation (urban trees) and reduced flash flooding, reduced smog formation due to lower temperatures	health, life, relocation expenses; business interruption
Efficient grid-independent lighting	reduced electricity use	disaster recovery	business interruption
Efficient windows	reduced space-cooling energy	improved fire-resistance and reduced vulnerability to wind-blown debris	property
Energy Sector -- Supply Side			
Renewable energy systems	reduced fossil fuel use	grid reliability	business interruption, service interruption, cyber-risk insurance (data loss), worker's compensation, property loss, liability, perishable goods interruption.
Distributed energy systems	reduced electricity transmission losses (and thus energy use)	grid reliability	Business interruption; more reliable power for early-warning systems and post-event operations
Hydroelectric systems	reduced ghg emissions	flood control	property, life/health
Biomass energy plantations	carbon sinks		
Agriculture, Forestry, and Land Use			
Agricultural soil management	increased soil carbon content	enhanced drought-resistance	crop
Land restoration and afforestation	carbon sinks	reduced flood/mudslide risk	property, crop
Mangrove protection/restoration	carbon sinks	enhanced flood and tidal-surge resistance	property, life/health
Health (Human and Other Systems)			
Improved forest management	reduced wildfires (carbon emissions)	reduced habitat for malaria vectors; flood control; reduced vulnerability to forest pests; retention of disease vectors (e.g. bats--Nipah virus) otherwise hazardous to humans	health, life, property
Ultraviolet water disinfection	reduced commercial energy use; reduced deforestation associated with water boiling	ability to respond to water quality crises following extreme weather events	health, life